



## **8.5.1 Operation of the RHIC 28 MHz Accelerator System**

### **1. Purpose and Scope**

To detail the proper operation of the RHIC 28 MHz accelerator system and to protect personnel and equipment during operation of the 28MHz accelerating systems.

### **2. Responsibilities**

- 2.1 RF Group personnel are responsible for compliance.
- 2.2 Line supervisors are responsible for determining when Lockout/Tagout procedures shall be used.
- 2.3 The supervisors shall verify that RF personnel using this procedure are currently qualified.
- 2.4 The Safety System Group is responsible for interlock testing and documentation. The Safety System Group is responsible for all RHIC Personal Access Security System (PASS) critical devices and related circuitry. See Attachment 4.

### **3. Prerequisites**

- 3.1 Training
  - 3.1.1 Lockout/Tagout (OSH-151B) for those individuals requiring access inside either the Anode Power Supply or power amplifier.
  - 3.1.2 Electrical Safety 1 (OSH-150B)
  - 3.1.3 Radiation Worker 1 (RWT-002)
  - 3.1.4 Radiation Safety Lockout/Tagout (RS-LOTO), as applicable.
  - 3.1.5 RS-LOTO Tag and Record Book
- 3.2 BNL Hold Tag and Tag Record Book
- 3.3 Film Badge (TLD).

- 3.4 The RHIC RF cavities are intense sources of x-rays when energized. The PASS is used to disable RF power supplies for tunnel access.

#### **4. Precautions**

- 4.1 Operation of the 28 MHz accelerating system requires the PASS Interlock System to be operational.
- 4.2 Testing which requires energizing of the high voltage Anode Power Supplies without the PASS RF-enable in place will require (RS-LOTO). In this case the H.V. cable (RG-219) must be disconnected from the Anode Power Supply and R.S. Loto Tag placed on its end.

#### **5. Procedure**

##### **5.1 PASS Operations for RF System**

- 5.1.1 Before starting amplifier or cavity operations which require the Anode Power Supply to be energized, the PASS must be in mode 24 ("No Access; modes 26, 25 [R.F. only-MCR, Local]).

##### **5.2 Amplifier and Cavity Operations**

- 5.2.1 First select "AUTO" or "MANUAL" control for the system from PLC control panel (see Figure 1).

5.2.2 if "AUTO"

5.2.2.1 Turn on filaments by pressing "STBY".

5.2.2.2 Wait for "HV READY/RESET" to light (approx. 6 minutes).

5.2.2.3 Turn on system by pressing "ON". This will turn on the ANODE (UVC), then the SCREEN (ALE), and then turn on the DRIVER (SORENSEN).

5.2.2.4 Turn ON RF drive.

5.2.3 If "MANUAL"

5.2.3.1 Turn on filaments by pressing "AUX ON".

5.2.3.2 Wait for "HV READY/RESET" to light ( approx. 6 minutes).

5.2.3.3 Turn on UVC Power Supply by pressing "ANODE ON".

5.2.3.4 Turn on ALE Power Supply by pressing “SCREEN ON”.

5.2.3.5 Turn on the SORENSON Power Supply by pressing “DRIVER ON”.

5.2.3.6 Turn on RF drive.

### 5.3 System Shutdown

5.3.1 Turn off RF drive.

5.3.2 Method 1 Manual Shutdown

5.3.2.1 Turn off the Driver Amplifier with “DRIVER OFF” button.

5.3.2.2 Turn off the Screen Power Supply with “SCREEN OFF” button.

5.3.2.3 Turn off the Anode Power supply with “ANODE OFF” button.

5.3.2.4 If desired, turn off filaments with “AUX OFF”.

5.3.3 Method 2 using “STBY” and “OFF”

5.3.3.1 Press “STBY” to turn off the High Voltage Power Supplies. This will leave the filaments on.

5.3.3.2 If desired, press “OFF” to turn off the filament power.

### **WARNING 1**

**In the event of a “radiation hazard enable” warning while tunnel access is permitted, the tunnel will be evacuated immediately and the Anode Power Supply(s) disconnect switch(s) shut off and locked out by MCR personnel until the Security Group clears the problem and PASS is retested.**

**If the MCR is not staffed then RF group personnel shall assume the LOTO responsibility, log the failure in the trouble log and notify the safety systems group at the next available staffed shift. In the event that the RF control room is to be left unattended then a cash cord will be actuated in the tunnel and the tunnel exited. This will cause PASS to be in the Safe Mode and require a controlled access operation to permit a mode change. The controlled access and reset keys will then be pulled from the local PASS control panel and RS-LOTO'ed in a lock box.**

## **WARNING 2**

**Testing and troubleshooting which requires the removal of the Power Amplifier covers or the opening of the 18kV Anode Power Supply doors shall be carried out under Lockout/Tagout procedures.**

### 5.4 Lockout/Tagout

Lockout/Tagout procedure should be performed by trained and authorized RF group personnel.

There are two independent procedures: one, which applies when accessing the Anode Power Supply Cabinet, and the second when accessing Power Amplifier Unit (located in the RHIC tunnel at 4 o'clock area).

Before accessing Anode Power Supply, the system must be down to at most filament power (step(s) 5.3.2.4 and/or 5.3.3.2 are not required).

Before accessing the Power Amplifier, the system must be OFF (step(s) 5.3.2.4 and/or 5.3.3.2 must be executed).

#### 5.4.1 Access of the Anode Power Supply Cabinet

1. Check for the presence of the 480Vac line voltages (L1-L2; L2-L3; L3-L1) in the Anode Power Supply Cabinet using Line Voltage Meter and the Line Switch (located at the front door of each Anode Power Supply Cabinet - see Fig. 2).
2. Turn off and Lockout/Tagout Anode Power Supply Disconnect Switch which is located at the wall in the Power Supply Building next to the particular Anode Power Supply Cabinet (see Fig. 2).
3. Check for the absence of the 480Vac line voltages in the Anode Power Supply Cabinet - all voltage reading (L1-L2; L2-L3; L3-L1) should be zero.
4. Turn off and Lockout/Tagout the Control Voltage Switch-located in the rear of the Power Supply Rack just above 120Vac strip (see Fig. 4). Access to the switch requires opening the back door of the Power Supply Rack.
5. Open the Anode Power Supply access door and place the Ground Stick at the positive terminal of the High Voltage capacitor (located

at the floor at the right side of the Anode Power Supply Cabinet (see Fig. 5).

#### 5.4.2 Access of the Power Amplifier Cabinet

1. Turn off and Lockout/Tagout Anode Power Supply disconnect switch associated with the Anode Power Supply, as per section 5.4.1 lines 1, 2 and 3.
2. Turn off and Lockout/Tagout the Filament Disconnect Switch-located in the Power Supply Rack. Verify LOTO by opening filament breaker box and using “wiggy” or equivalent meter, verifying meter by testing AC input test points at top of switch and absence of 480V AC on fuses. Power Supply Rack stands next to the particular Anode Power Supply Cabinet. Switch is located in the rear of the cabinet (see Fig. 3). Access to the switch requires opening the back door of the Power Supply Rack.
3. Turn off and Lockout/Tagout the Control Voltage Switch-located in the rear of the Power Supply Rack just above 120Vac strip (see Fig. 4). Access to the switch requires opening the back door of the Power Supply Rack. Verify LOTO by testing AC outlet strip for 110V AC “wiggy” or equivalent meter.
4. Open the Anode Power Supply cable access port located in the Power Amplifier cabinet and discharge any residual HV by placing the Ground Stick at the anode connection of the cable (see Fig. 6).

### 6. **Documentation**

- 6.1 Cognizant engineer/physicist/technician shall maintain a development logbook.
- 6.2 Tag Record Book
- 6.3 RS-LOTO Record Book

### 7. **References**

None

**8.     Attachments**

1.       Figure 1 - RF Control Rack Redi Panel  
          Figure 2 - Anode Power Supply Cabinet
2.       Figure 3 - Filament Disconnect Switch  
          Figure 4 - Control Voltage Switch
3.       Figure 5 - Positive Terminal of the High Voltage Capacitor  
          Figure 6 - Anode of the Power Tube
4.       RF Critical Device List

## Attachment 1

### **Redi Panel**



Figure 1

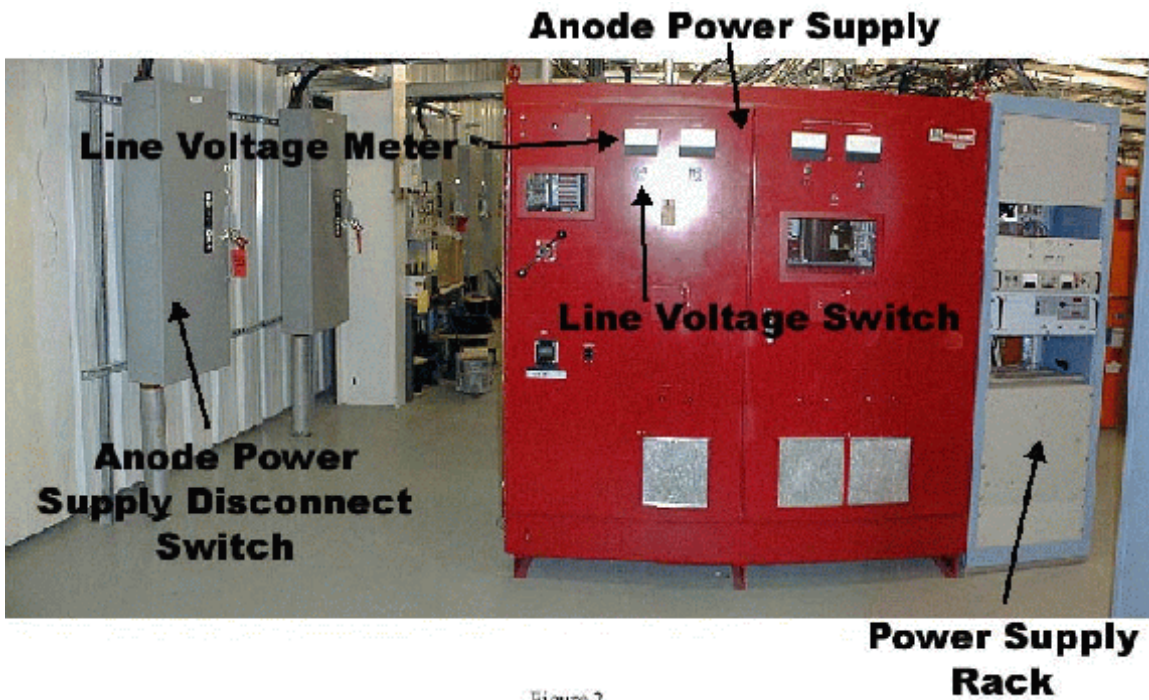


Figure 2

## Attachment 2

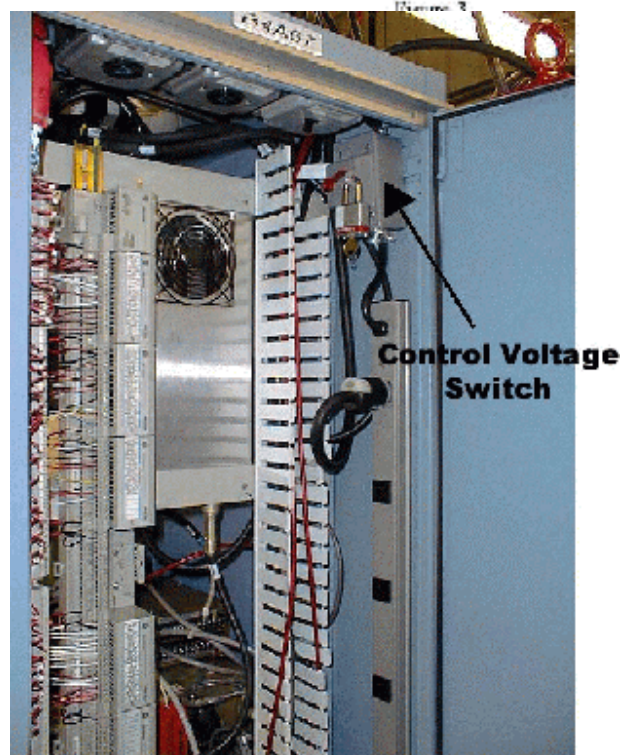
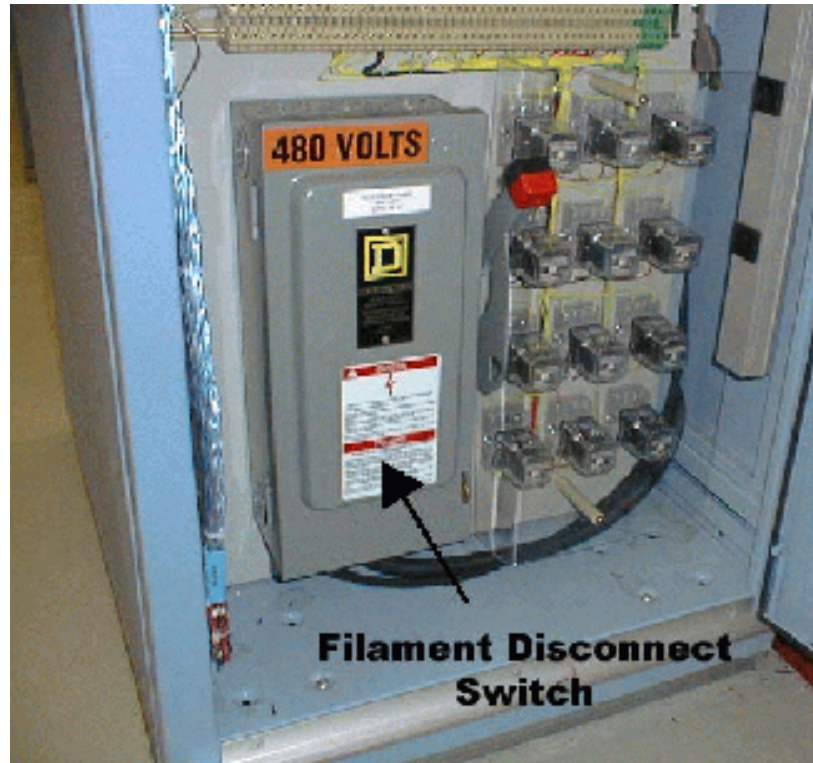


Figure 4

### Attachment 3

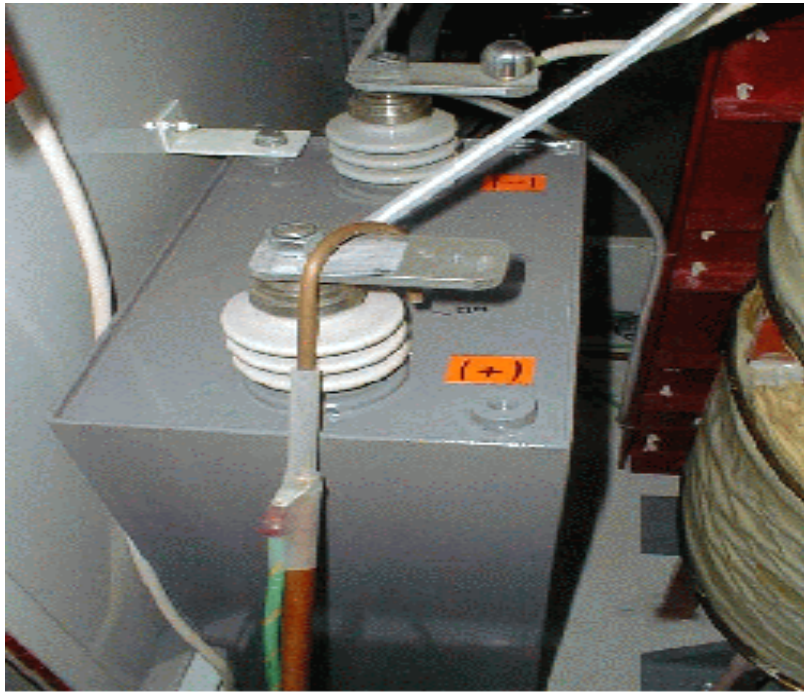


Figure 60



Figure 61

## Attachment 4

### RF Critical Device List

Personnel Access Security System (PASS) connections to critical devices in RHIC RF System Anode Power Supplies (Drawing number 71025000).

The PASS critical devices (RF-CD1 and RF-CD2) for inhibiting RF power to the cavities are located in the High Voltage Anode Power Supplies. **Before starting work on the following subsystems, the security group must be notified.** The system must be Radiation Safety Locked Out/Tagged Out (RS-LOTO) by authorized personnel. After completing the work, the components must undergo a functional recheck as determined by the Security Group personnel.

1. K101F
2. K102
3. K106 (B)
4. A2K1B
5. PC Board A2
6. K120, R120
7. K121, R121
8. K122, R122
9. K123
10. K124
11. K125, R125
12. K126, R126
13. K127, R127
14. TB101
15. TB112

The power supply is a QA A1 device, and no substitution or modification of any parts may be undertaken without an Engineering Change Notice (ECN). Preventive maintenance and repairs, including replacing defective parts to subsystems not itemized on the restrictive list, may be performed by RF Group personnel without notifying the Security Group. When troubleshooting the power supply, external sources of power (110VAC or 24VDC, etc.) may not be introduced downstream of the critical devices actuating relays.